510401

Total No of Pages: 3

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B. Tech. V - Sem. (Main) Exam., December - 2020

Computer & Science Engineering

5CS3 – 01 Information Theory and Coding

Time: 2 Hours

Maximum Marks: 80
Min. Passing Marks:

Instructions to Candidates:

Part – A: *Short answer questions (up to 25 words) 5 × 2 marks = 10 marks. All **five** questions are compulsory.*

Part – B: *Analytical/Problem solving questions 4 × 10 marks = 40 marks. Candidates have to answer **four** questions out of **six**.*

Part – C: *Descriptive/Analytical/Problem Solving questions 2 ×15 marks = 30 marks. Candidates have to answer **two** questions out of **three**.*

Schematic diagrams must be shown wherever necessary. Any data you feel missing may suitably be assumed and stated clearly. Units of quantities used/calculated must be stated clearly.

Use of following supporting material is permitted during examination. (Mentioned in form No. 205)

1. NIL

2. NIL

PART – A

Q.1 What is Entropy? Explain its properties? [2]

Q.2 An event has 6 possible outcomes with the probability $p_1 = \frac{1}{2}$, $p_2 = \frac{1}{4}$, $p_3 = \frac{1}{8}$, $p_4 = \frac{1}{16}$, $p_5 = \frac{1}{32}$, $p_6 = \frac{1}{32}$. Find the entropy of the system. [2]

Q.3 What are the convolutional codes? How are they different from block-codes? [2]

Q.4 What is Galois Field (GF)? [2]

Q.5 State Shannon – Hartley theorem. [2]

PART – B

Q.1 Given 6 messages m_1, m_2, m_3, m_4, m_5, m_6 with $p(m_1)=\frac{1}{3}$, $p(m_2)=\frac{1}{4}$, $p(m_3)=\frac{1}{8}$, $p(m_4)=\frac{1}{8}$, $p(m_5)=\frac{1}{12}$, $p(m_6)=\frac{1}{12}$. Find the Shannon Fano code. Evaluate the coding redundancy. [10]

Q.2 A distance source transmits messages x_1, x_2 and x_3 with the probabilities 0.3, 0.4 and 0.3. The source is connected to the channel given in fig. (1). Calculate all the entropies - https://www.btubikaner.com [10]

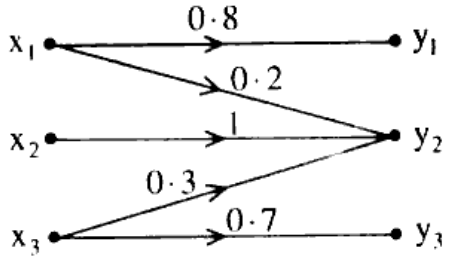

fig. (1)

Q.3 For the (6, 3) Hamming Code, the parity check matrix H is given by - [10]

$$H=\left[\begin{array}{ccc:ccc} 1 & 0 & 1 & 1 & 0 & 0 \\ 0 & 1 & 1 & 0 & 1 & 0 \\ 1 & 1 & 1 & 0 & 0 & 1 \end{array}\right]$$

(a) Construct the generator matrix.

(b) Determine the code word that begin with [1 1 0].

(c) If the received vector y is [0 1 1 0 1 0]. Then calculate the Syndrome.

Q.4 With the help of suitable example, explain the Viterbi algorithm for the decoding of convolutional code? [10]

Q.5 Apply Huffman's encoding procedure to the following message ensemble – [10]

$[X] = [x_1\ x_2\ x_3\ x_4\ x_5\ x_6\ x_7]$

[P] = [0.4 0.2 0.12 0.08 0.08 0.08 0.04]

Take M = 3, Calculate: (i) Entropy (ii) Average Length (iii) Efficiency

Q.6 Write short notes on - [10]

(a) Code Tree

(b) Code algebra and cyclic code

PART – C

Q.1 For a (6, 3) systematic linear block code the three parity-check bits C_4, C_5 and C_6 are formed from the following equations - [15]

$$C_4 = d_1 \oplus d_3$$

$$C_5 = d_1 \oplus d_2 \oplus d_3$$

$$C_6 = d_1 \oplus d_2$$

(a) Write down the generator matrix G.

(b) Construct all possible code words.

(c) Suppose that the received word is 010111. Decode this received word by finding the location of the error and the transmitted data bits.

Q.2 (a) Prove that the channel capacity of a white band limited Gaussian channel is- [10]

$$C = W \log\left(1 + \frac{S}{N}\right) \frac{\text{bit}}{\text{sec.}}$$

Where

W = Channel Bandwidth

$\frac{S}{N}$ = Signal to Noise Ratio

(b) A Gaussian Channel has 1 MHz bandwidth. Calculate the channel capacity if its signal power to noise spectral density ratio is 5×10^4 (Hz). Also find the maximum information rate. [5]

Q.3 Write short note on - [15]

(a) Trellis diagram

(b) ARQ methods of Error control coding

(c) BCH code
